Equation of State of Nuclear Matter, and Neutron-Rich Nuclei in Laboratories and in Neutron-Star Crusts

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We examine a relationship between the phenomenological equation of state (EOS) of nuclear matter near normal nuclear density and the structure of neutron stars. In this study, we use about 200 EOS's, which are systematically constructed in such a way as to provide a reasonable fit to empirical masses and radii of stable nuclei by simplified Thomas-Fermi calculations. It is found that the boundary density between the core and crust of neutron stars is a decreasing function of the symmetry energy density derivative coefficient L. We also find that the neutron star mass at fixed central density is an increasing function of L, and that L must be large enough to support a neutron star having the observed canonical mass (1.4 solar mass). These features could provide a constraint on the L value, which would complement a possible constraint to be obtained from systematic measurements of radii of neutron-rich nuclei. We expect, on the other hand, that the L value, once determined experimentally, would enable us to describe more precisely the structure of neutron stars having low central densities (2-3 times the nuclear density).